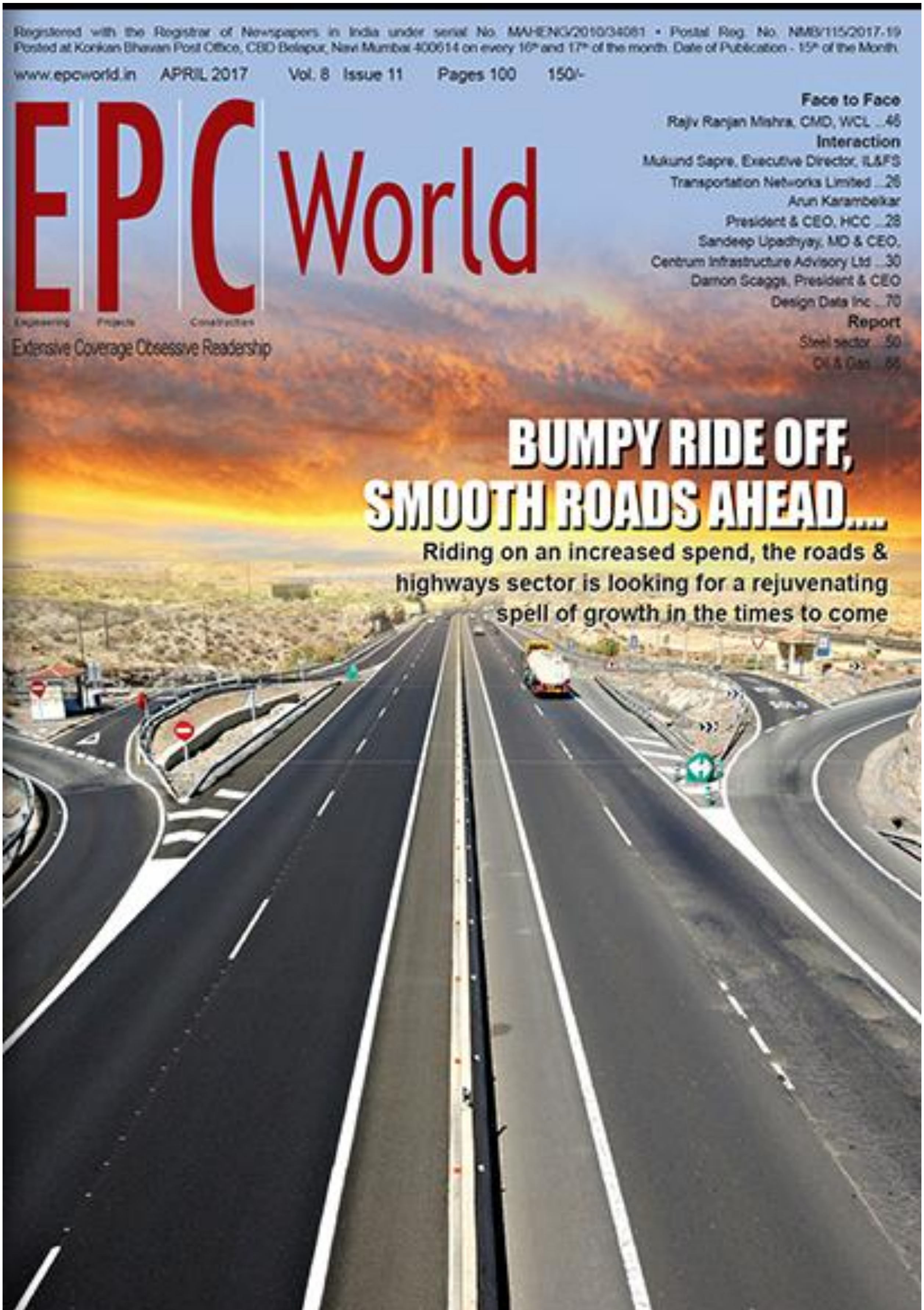
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Riding on an increased spend, the roads & highways sector is looking for a rejuvenating spell of growth in the times to come

# Analysis of Isolation Frame failure of a Screen for achieving optimum vibration

**This article relates to a screen assembly for separating rock material, and more particularly to a modified vibrating screen that enhances the screen assembly's ability to resist cracking of the screen decks and side plates and prevents overall screen assembly failure and thereby enable increased vibration.**

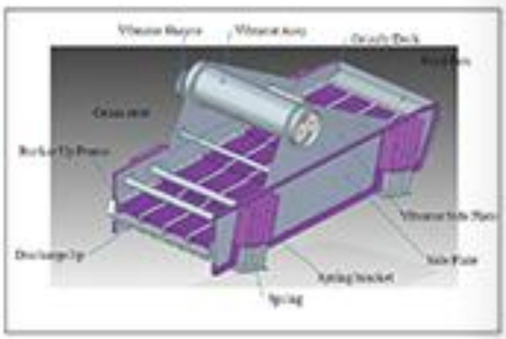
Reliability is a key factor for the design and manufacture of vibrating screen. Dynamic characteristics of the vibrating screen were researched and dynamic simulation method of screening machines was explored. We have used finite element method (FEM) to analyze dynamic characteristic of large vibrating screen with hyper static net-beam structure. Multi natural frequency, natural modes of vibration and dynamic response of the vibrating screen were calculated. The structural size of stiffeners on the side plate was optimized under multiple frequency constraints and an adaptive optimization criterion was given.

## Introduction

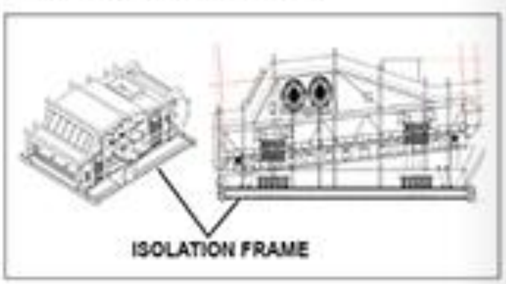
Screen assemblies are used in the aggregate business for separating rock, crushed rock, gravel sand, and the like (referred herein as material) into various sizes. Screen assemblies typically comprise one or more screen decks containing a perforated screening medium, which acts as a sieve through which the material is separated. A charge of material is deposited on the receiving end (feed box) of the screen deck of a screen assembly and as the material is conveyed to the discharge end, smaller material falls through the openings leaving the larger material retained on the screen deck.

The structural strength and stiffness needs to be improved with the maximization of screening effect in the machine. The enlargement of structure of vibrating screen will lead to the increase in vibration mass and exciting force. Dynamic load on the vibrating screen will also increase which will lead to a greater deformation, tear of the side plate, fracture of the crossbeam and thus the service life of the vibrating screen seriously. Conventional static strength calculation and analogy method was used in the design of vibrating screen which neglects the dynamic characteristics influence of higher modal frequencies on the vibrating screen. High exciting force is likely to lead to fatigue damage of vibrating screen. Engineering experience indicates that the screen can also be damaged even if the static strength meets the performance requirement adequately. Thus the performance, structure and strength need to be analyzed dynamically in the design process. For this a new frame of vibrating screen was developed to fit the maximum requirement of screening machines, improve the reliability and extend service life through dynamic design i.e. incorporation of Isolation Frame to support the main screen.

### MAIN PARTS OF A SCREEN

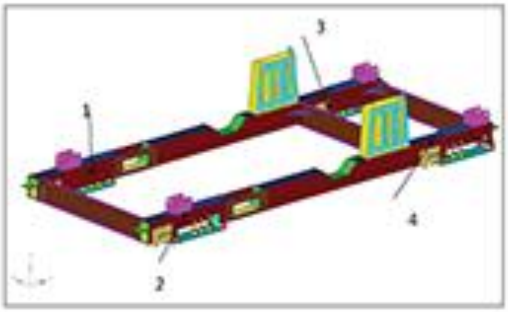



### ISOLATION FRAME IN A SCREEN



## ANALYSIS

In this article we have studied and analyzed failure of isolation frame of a screen used in Europe by a steel manufacturing company. This isolation frame is supporting the main screen at four locations (1, 2, 3 & 4) as shown in the figure.




Vibration in a screen has a unique feature; on one hand, vibration is a key functional element where the energy of vibration is used to move or classify the material. On the other hand, vibration can cause damage to the machine parts and therefore it is also important to mitigate its effects. CAE analysis can help to meet both these requirement. The scope of study at present is the analysis of second problem, where a machine experienced premature failure and analysis was done to explore possible reason.

Static Analysis and Frequency Response Analysis of the Isolation Frame were carried out.

Above analysis was done for two following cases;

1. Second mass frame with spring at four locations
2. Second mass frame with spring at two locations and rigid element at two locations (Non-functioning of spring due to accumulation of sand under the springs.)

### Static Analysis

The results can be summarized as follows: If the screen works in the designed condition, the stress levels are reasonably low throughout the structure and failure is not likely to occur in line with figures 1 & 2 given below.

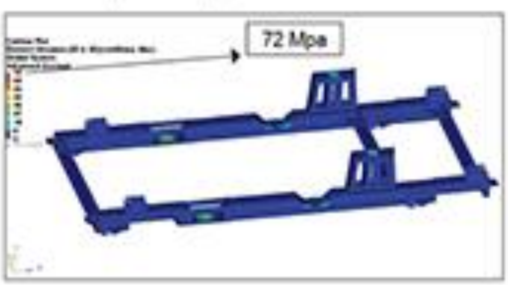



Fig. -1

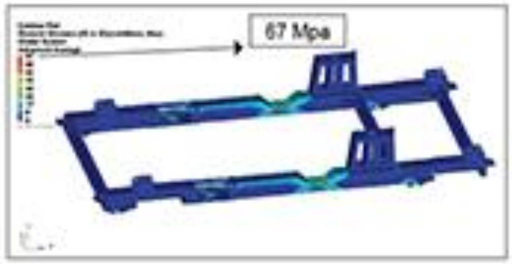



Fig. - 2

However, if one end of the spring is jammed by sand, a specific resonance is triggered that gives rise to stresses but within the limit as shown in figures 3 & 4 as compared with the yield stress of steel 250 Mpa.

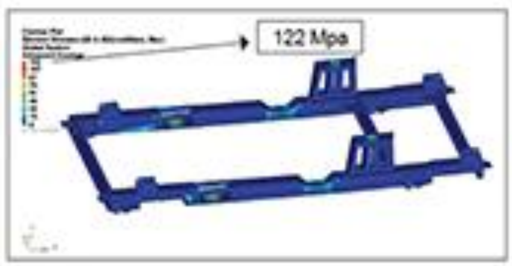
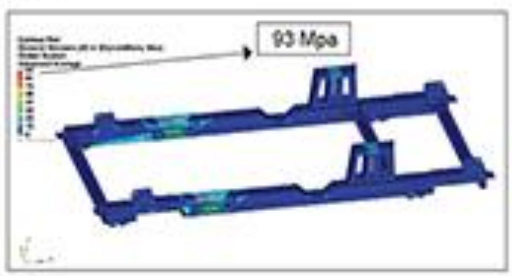
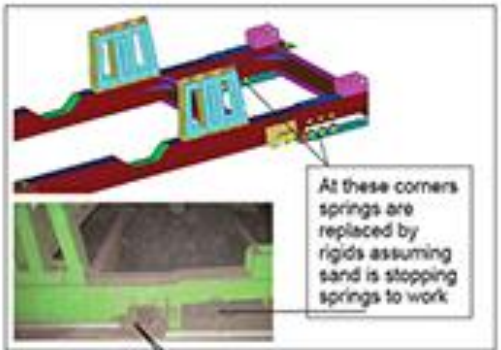



Fig. -3



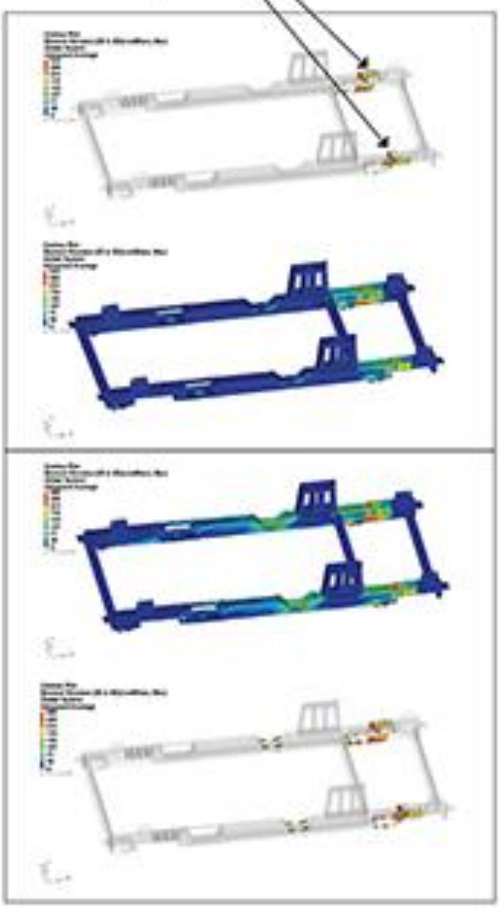
### Fig. - 4

Actual condition of the machine has been shown in figure 5.




### Fig. -5

The high stress area matches the observed failure zone as indicated in the figure-6 below.

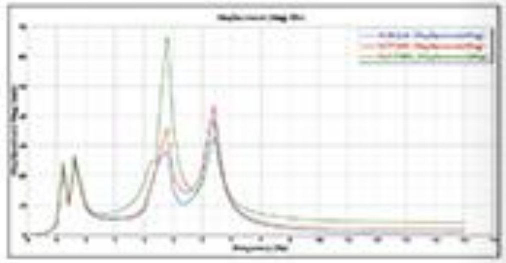


### Fig. - 6

From the above results, the reason for failure was not clear hence, Frequency Response Analysis was carried out to know the dynamic stresses on the frame.

## Frequency Response Analysis

Case 1 - When all the four springs are in working condition.



### Fig. - 7

From the above graph, 1.2 Hz, 1.6 Hz, 4.8Hz & 6.4 Hz frequencies are showing the resonance.

The stresses at these frequencies are 25 Mpa, 60 Mpa, 60 Mpa & 50 Mpa respectively at the mid span of the frame (at screen spring location local stress can be neglected due to FE modeling assumptions). The result shows that the stresses are well within the limit. (Refer figure 8).

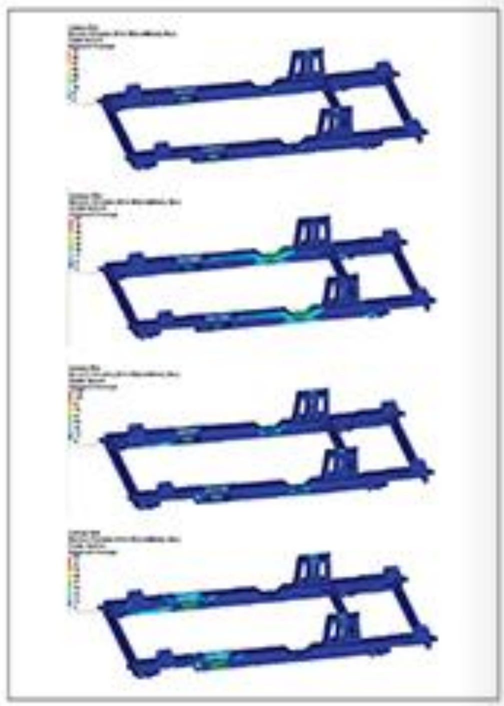


**Fig. -8**

Case 2- When only two number springs are in working condition two are jammed with sand.

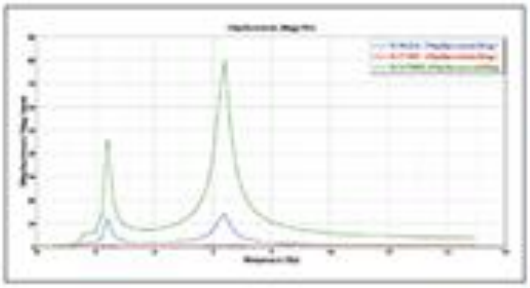


**Fig. - 9**

From the above graph, 2.4 Hz & 6.4 Hz frequencies are resonant frequencies.

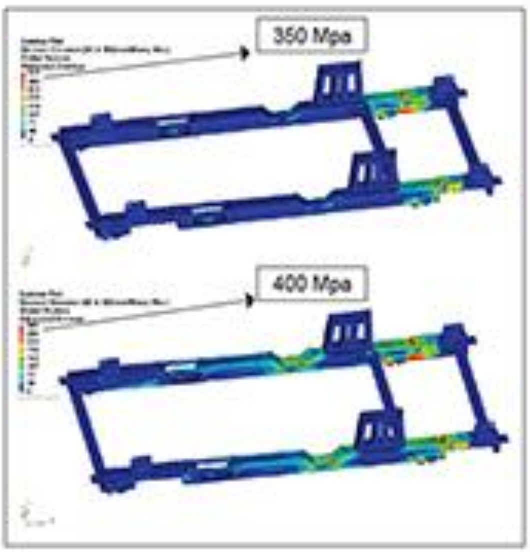



**Fig. - 10**

The stresses at these frequencies are 350 Mpa & 400 Mpa respectively. Which is very high compared to the yield stress of the material and is likely to fail from its weakest part as indicated in the failed second mass frame (red zone, Figure-10)

## RESULTS & CONCLUSION


- The indicated areas are showing high stress zone in case of non-functioning of isolation frame due to sand accumulation on spring at two corners.
- From the frequency response results, it is validated that the region is too weak to sustain this condition.
- From the result, it is also clear that if all the springs function well then the structure is robust/stable enough to withstand specified loading condition.
- To overcome this problem, constant cleaning has been recommended beneath the spring and additional stiffener on isolation frame has been added through proper analysis of the modification.

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